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(54) **A FUEL PUMP FOR SUPPLYING FUEL TO AN INTERNAL COMBUSTION PISTON ENGINE**

KRAFTSTOFFPUMPE FÜR EINE VERBRENNUNGSKRAFTMASCHINE

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EP 3 601 778 B1

Description

Technical field

[0001] The invention relates to a fuel pump according to the preamble of claim 1.

Background art

[0002] Internal combustion piston engines need to be provided with one or more fuel pumps. Particularly the fuel injection in so called common rail systems into the combustion chambers of the engine requires capability of pumping the fuel into high pressure of even above 250 MPa. Since the pumps are typically lubricated by the lubrication oil of the engine the presence of both the fuel and the lubrication oil in the pump may call for special attention particularly relating to preventing or minimizing the mixing of the fuel and the lubricant in the pump.

[0003] Document EP 1 184 568 A2 discloses a fuel pump according to the preamble of claim 1.

[0004] Document EP 0976926 B1 discloses an integrated pump and tappet unit for supplying fuel to an internal combustion engine, such as a large diesel engine, the unit comprising a body part enclosing a tappet member, whose axial movement is governed by movement of a cam surface provided on a cam shaft or the like, and a piston member operationally connected to the tappet member and which is arranged to pump fuel under high pressure from a fuel chamber disposed within the body part. The body part is a single member housing both said tappet member and said fuel chamber and the tappet member and the piston member are connected to each other by means of a tappet arm, which is sealed to a flange member fixed to the body part, so that fuel from the fuel chamber is prevented from coming into contact with the tappet member.

[0005] Document DE 102015002304 A1 discloses a high pressure fuel pump. Document is silent about the possible leakage of the fuel into the lubrication oil but shows a lubrication system of the pump. The pump comprises a pump housing having an inner space, a pump plunger with a guide surface, which is guided in the interior space on the pump housing, wherein the interior space and the pump plunger limits a spring chamber of the high-pressure fuel pump, a lubricant line which opens into the interior space against the guide surface of the plunger, a vent pipe, by means of which the lubricant can be discharged from the spring chamber.

[0006] Document DE102008042067 A1 discloses a pump which has a drive shaft provided with an eccentric cam, and a piston accommodated in a cylinder. The document discloses circular membrane seals used for separating the fuel and lubrication systems from each other.

[0007] Document DE102006059333 A1 discloses a fuel pump comprising at least one wiper element integrated in the pump piston for removing leakage fuel collecting between the pump cylinder and the pump piston from the cylinder wall. The wiper element is a scraper ring that removes leakage fuel accumulating on the wall of the pump cylinder and guides it into at least one leakage groove.

[0008] US7308849 defines a work chamber and driven at least indirectly by a drive shaft in a reciprocating motion, counter to the force of a restoring spring. The pump piston is braced on the drive shaft at least indirectly via a sleeve like tappet, and the restoring spring engages at least the pump piston. A support element in the tappet braces the pump piston toward the drive shaft and is braced at least indirectly on the drive shaft. The restoring spring, via a spring plate, engages the pump piston and the tappet. The spring plate is elastically deformable in the direction of motion of the pump piston in such a way that as a result of its elastic deformation, deviations in the position of its contact faces on the pump piston and on the tappet are compensated for.

[0009] WO2011160908 A1 discloses a pump which comprises at least one pump element which has a pump piston that is at least indirectly driven in a stroke movement by a drive shaft. A plunger having a plunger body is arranged between the drive shaft and the pump piston and is movably guided in a receiving device in the direction of the stroke movement of the pump piston and is supported on the drive shaft by means of a support element. Lubricant is supplied to the receiving device via a supply line and lubricant is conducted out of the receiving device via a discharge line into the plunger body to the support element. An annular gap filter is provided between the plunger body and the receiving device and is arranged between the supply line for supplying lubricant to the receiving device and the discharge line for discharging lubricant into the plunger body.

[0010] An object of the invention is to provide a fuel pump for supplying fuel to an internal combustion piston engine in which the performance is considerably improved compared to the prior art solutions.

Disclosure of the Invention

[0011] The objects of the invention can be met substantially as is disclosed in the independent claim 1. Dependent claims 2-5 describe preferred embodiments of the invention.

[0012] According to the invention a fuel pump according to claim 1 is provided.

[0013] According to an embodiment of the invention the vent flow path is provided with a one-way valve allowing flow towards the second space section.

[0014] According to an embodiment of the invention the discharge flow path is provided with a one-way valve allowing flow away from the second space section.

[0015] According to an embodiment of the invention the annular gap in the second space section circumscribes the first space section at least partially such that the annular gap and the first space section are overlapping with each other in the direction of the central axis of

the cylindrical space.

[0016] According to an embodiment of the invention the cylindrical extension is a bushing removably attached to the body of the pump.

[0017] The present invention is suitable for use as a high pressure pump in a common rail fuel system.

[0018] The exemplary embodiments of the invention presented in this patent application are not to be interpreted as limiting. The scope of the invention is solely defined by the appended claims.

Brief Description of Drawings

[0019] In the following, the invention will be described with reference to the accompanying exemplary, schematic drawings, in which

Figure 1 illustrates a fuel pump according to an embodiment of the invention,

Figure 2 illustrates a fuel pump according to another embodiment of the invention,

Figure 3 illustrates a fuel pump according to an example which is not a part of the claimed invention, and

Figure 4 illustrates a fuel pump according to still another embodiment of the invention.

Detailed Description of Drawings

[0020] Figure 1 depicts schematically a fuel pump 10 configured to supply fuel to an internal combustion piston engine. More particularly the pump is a high pressure pump configured to deliver fuel at a pressure of above 200 MPa. The pump 10 is provided with a supply rail 12 and a high pressure rail 14 which are both in connection with a first pump chamber 16 arranged to a body 18 of the pump 10. The body 18 comprising the pump chamber 16 may also be referred to as a barrel of the pump 10. The supply rail 12 is connected to the pump chamber 16 via an intake conduit 20. The high pressure rail is connected to the pump chamber 16 via an outlet conduit 22. The intake conduit 20 is provided with a one-way valve 24 configured to allow fuel to flow only from the supply rail 12 to the pump chamber 16. Respectively, the outlet conduit 22 is provided with a one-way valve 26 configure to allow fuel to flow only from the pump chamber 16 to the high pressure rail 14. In the embodiment shown in the figure 1 the supply rail 12 and the high pressure rail 14 are integrated into the body 18 but it is conceivable that the rails are external to the body 18.

[0021] The pump 10 is also provided with a piston member 28 which is arranged into a cylindrical space 30 arranged into the body 18. The cylindrical space 30 has a central axis 32 and it is substantially rotationally symmetrical in respect to the central axis 32. Therefore the piston member 28 is also rotationally symmetrical in respect to the central axis 32.The outer form of the body may be designed according to the needs. The piston member 28 is arranged into the space in re-ciprocatable manner. The piston member 28 has a first end 28' which borders the cylindrical space 30 at an end thereof forming the first pumping chamber 16. The piston has also a second end 28" opposite to the first end 28'. The piston member 28 is configured to reciprocate in the space 30 provided for the piston member 28 and pump the fuel. This way the reciprocating piston member together with the one-way valves 24, 26 provides the pumping effect of the fuel pump. The piston member 28 is advantageously an assembly of several parts, which is here illustrated so that the first end 28' and the second end 28" are separate parts removably connected to each other.

[0022] The cylindrical space 30 comprises a first space section 30' which has a first diameter D1. In the first space section 30' the wall of the space section and the wall of the piston member 28 are arranged against each other providing a first sealing gap 34 between the walls, which also guides the piston member 28 in the body 18. Additionally the wall of the first space section guides the piston member in the body 18 while it reciprocates in the space. The piston member 28 comprises a first portion which is arranged into the first space section 30' and has a diameter substantially same as the first diameter such that a desired guidance and sealing is provided.

[0023] The cylindrical space 30 comprises also a second space section 30" which has a second diameter D2, being greater than the first diameter D1. The second space section 30" is on same central axis as the first space section 30'. The piston member 28 comprises a second portion which is arranged in the second space section 30" such that a desired guidance and sealing is provided. In the second space section 30" the wall of the second space section and the wall of the piston member 28 are arranged against each other providing a second sealing gap 35 between the walls, respectively. Additionally the wall of the second space section guides the piston member at its second portion in the body 18 while the piston member reciprocates in the space.

[0024] There is a second pump chamber 16' arranged to a body 18 of the pump 10. The second pump chamber 16' is arranged in connection with the second space section 30" such that second pump chamber 16' is configured to use empty space of the second space section 30" as the pump chamber. The piston member 28 is arranged to border both the first and the second pump chamber 16, 16'.

[0025] The piston member 28 and the first and the second pump chambers are configured in the pump shown in the figure 1 such that volumes of the first and the second pump chambers are changing same way i.e. either increasing or decreasing, during the piston member is moving to one direction.

[0026] As mentioned above, in the first space section 30' the wall of the space section and the wall of the piston member 28 are arranged against each other providing the first sealing gap 34 between the walls. The first sealing gap 34 separates the first pump chamber 16 and the

second pump chamber 16' and it is of annular form. Since the first pump chamber 16 operates as a high pressure pump configured to deliver fuel at a pressure at above 200 MPa the fuel in the first pump chamber tends to flow into the first sealing gap 34 and further to flow through the sealing gap 34. Even if not shown here the first sealing gap 34 between the pump chambers 16, 16' may be provided with means to collect fuel material flown from the first pump chamber 16 into the first sealing gap 34. Such a means may comprise a groove arranged to the wall of the first space section provided with a conduit to lead the fuel material to further processing. Since the second pump chamber 16' is within the second space section 30" there may be commonly referred to in the following.

[0027] The pump 10 is provided with means for transferring fuel material away from the second pump chamber 16'. Therefore firstly the pump 10 is provided with a vent flow path 36. The vent flow path 36 runs through the body 18 of the pump and connects the second pump chamber 16 which is formed into the second space section 30" to outside of the body 18. The vent flow path 36 is configured to allow gas admission into the second space section 30", driven by the reciprocating movement of the piston member. The pump 10 is further provided with a discharge flow path 38 connecting the second pump chamber 16' to outside of the body 18 configured to transfer fuel material entered into the second pump chamber 16' or the second space section 30" via the sealing gap 34 away from the second space section 30" i.e. the second pump chamber 16'.

[0028] The vent flow path 36 is provided with a one-way valve 40 which allows gas flow in the vent flow path 36 in the direction towards the second space section 30" and prevent back flow of the fluid. The vent flow path 36 has an inlet which opens into the surroundings of the pump 10. Respectively, the discharge flow path 38 is provided with a one-way valve 42 configured to allow flow away from the second space section 30" via the discharge flow path 38. During compression stroke of the volume of the second pump chamber 16' is reduced and due to that it is pressurized. Gases and liquids within the second pump chamber 16' are forced out from the second pump chamber 16' via the discharge one-way valve 42. During suction stroke of the pump also the second pump chamber 16' expands causing suction through the vent one-way valve 40.

[0029] In the figure 1 the piston member 28 is at its first extreme position where the first pump chamber 16 has its smallest volume. The piston member 28 is movable by an external force, depicted by an arrow 44, which may be provided directly by the operation of the engine.

[0030] The piston member 28 is provided with a sleeve member 46 which connects to the second end 28" of the piston member 28 and which has a closed end i.e. a bottom 58. The bottom 58 of the sleeve member 46 extends radially to the piston member 28. The sleeve member 46 may be integral to or separate part from the second end 28" of the piston member 28 and/or the sleeve member 46. The bottom 58 of the sleeve member 46 is therefore common with the piston member 28 and it serves for receiving the force needed for reciprocate the piston member 28 in the pump 10. The sleeve member is arranged such that an annular space is provided between the sleeve member 46 and the piston member 28, which now forms the second pump space 16'. The sleeve member 46 opens towards the first end 28' of the piston member 28. The sleeve member is arranged into the second space section 30" such that the radially inner wall of the second space section 30" and the radially outer wall of the sleeve member 46 are against each other providing a second sealing gap 35. The wall of the second space section 30" guides the sleeve member 46 of the piston member 28 in the body 18 when the piston member 28 and sleeve member are moving along the central axis 32.

[0031] The body 18 of the pump 10 is provided with a cylindrical extension 48 towards the second end of the piston member 28 which extension is coaxial to the first space section 30'. The cylindrical extension 48 has an axial length in the direction of the central axis 32 and an outer diameter smaller than the second diameter D2. The cylindrical extension 48 extends axially into the second space section 30". This way the cylindrical extension 48 forms an annular gap 47 radially between the cylindrical extension 48 of the body and the inner wall of the body. The annular gap 47 circumscribes the first space section at least partially such that the annular gap of the second space section 30" and the first space 30' section are overlapping with each other in the direction of the central axis 32 of the cylindrical space. The sleeve member 46 is arranged to extend into said annular gap 47. The end face of the cylindrical extension 48 borders the second pump chamber 16' together with the piston member 28 and the sleeve member 46. The fitting of the sleeve member 46 extending into the annular gap between the cylindrical extension 48 and the second space section 30" is such that the radially inner wall of the annular gap i.e. the cylindrical outer wall of the extension 48 and the radially inner wall of the sleeve member 46 are against each other providing a third sealing gap 37.

[0032] There is third space section 60 arranged into the annular gap radially between the cylindrical extension 48 and the inner wall of the body and the sleeve member 49 which borders the third space section. The third space section serves for purposes of lubrication the pump 10. The pump 10 is provided with lubrication oil supply channel 62 and a lubrication oil discharge channel 64. The minimum volume of the third space section 60 and the locations and/dimensions of the lubrication oil supply channel 62 and the lubrication oil discharge channel 64 are configured to allow a formation of a pond of lubrication oil in the third space section but preventing a total filling of the third space section with the lubrication oil. Particularly the lubrication oil supply channel 62 and the lubrication oil discharge channel 64 are dimensioned so that the flow rate of the lubrication oil out from the third space section 60 is at least in the long run greater than the flow

rate of the lubrication oil in to the third space section 60.

[0033] The vent flow path 36 extends through the body 18 to the inner wall of the second space section 30" where its outlet 50 is arranged. The vent flow path 36 continues in the sleeve member 46 and it opens into the second pump chamber 16' via an outlet 52 of the vent flow path. The transition area between the vent flow path 36 in the body 18 and in the sleeve member 46 is provided with an oblong space 54 extending in the direction of the center axis 32 into which space the vent flow path opens. This way the flow path is open at all operational positions of the piston member 28 and the sleeve member 46. The vent flow path and the discharge flow path may be realized by providing suitable bores, grooves or otherwise provided channels into the material of the pump 10. In the embodiment of the figure 1 the oblong space 54 is provided as an indentation, into the outer wall of the sleeve member 46, but it is conceivable to arrange that also to the inner wall of the body 18. The discharge flow path 38 is provided with similar oblong space 54 for bring about a flow connection between discharge flow path 38 in the piston member 28 and in the body 18.

[0034] Now, when installed to an internal combustion engine, the external force 44 is advantageously brought about by a power system of the engine. Therefore the piston member 28 is in mechanical force transmission connection, typically indirectly, with the crankshaft of the engine. In practise this mean that mechanical force transmission is lubricated by the engine lubricant. The pump 10 is provided with means for transferring fuel material away from the second pump chamber 16' any fuel material which escapes through the sealing gap 34 will not find its way into the lubrication oil of the engine.

[0035] In the figure 2 there is shown an embodiment of the invention where the pumping effect in the second pump chamber 16' is accomplished without one-way valves by suitably located vent flow path 36 and discharge flow path 38 inlets and outlets into the piston member and the body. The oblong spaces 54 are located so that situated that the vent flow path 36 is open when the piston part is in a suction stroke which makes is possible to balance the created underpressure in the second pump chamber 16'. The vent flow path 36 and discharge flow path 38 inlets and outlets are so arranged that when the piston member moves towards it first end 28' the vent flow path is closed and the pressure is increasing in the second pump chamber 16'. At a certain position of the piston member 28 the discharge flow path 38 opens and the second pump chamber is discharged.

[0036] In the figure 3, which shows an example which is not a part of the claimed invention, there is shown a pump unit 10 where the structure of the second pump chamber 16' is different to that shown in the figures 1 and 2. Here the piston member 28 extends from its first end through a guide flange 56 to a cam drive system (not shown) of the pump 10. The piston member 28 is provided with a bottom 58 as a radial extension part, which borders the second pump chamber 16'. In this case there is not a sleeve member 46 provided in connection with the bottom 58.The radial distal end of the bottom 58 is adequately sealed against the inner wall of the second space section 30" such that pumping effect can be obtained by the second pump space 16'.. A feature that is common to all of the figures 1 - 3 is that the discharge flow path 38 opens into a part which borders the second pump chamber 16' farthest from the first end of the piston member. When the pump is at the position as is shown in the figures 1-2 (center axis 32 is vertically positioned and the first end 28' of the piston member is upwards oriented) the discharge flow path 38 opens into lowest position in the second pump chamber 16'. In practise the center axis 32 need not be exactly vertical but the pump may be tilted as long as the discharge flow path is arranged to substantially lowest position into the second pump chamber 16'.

[0037] In the figure 4 there is shown an embodiment of the invention where the pump 10 is configured to be installed such that the first end 28' of the piston member 28 is horizontally below the second end 28" of the piston member 28. The basic configuration of the pump 10 is similar to that shown in the figure 1 being though such features, which are effected by the departing orientation, designed differently. In the figure 4 there is shown that the first sealing gap 34 is provided with a fuel scraper ring 68 in an annular space arranged to minimize the flow of fuel into the second space section 30". There is also another annular space 67 closer to the first pump chamber 16 from which a fuel discharge channel 66 is extending to outside the body 18. Even if not shown, similar fuel scraper ring 68 and fuel discharge channel 66 may be arranged to the pumps shown in the figures 1 to 3. This arrangement decreases the amount of fuel flow through the first sealing gap 34 to the second pump space 16', but the fuel directed to the fuel discharge channel 66 is still at considerably high pressure.

[0038] In the pump 10 shown in the figure 4 the second space section 30" is provided with a bushing 70. The bushing is generally cylindrical part having an outwardly extending shoulder at its first end. It is at its first end attached to the inner surface of the second space section 30" and it is provided with a section having a smaller diameter than the second space section 30" such that an annular space 60 is provided between the bushing 70 and the inner surface of the section space section 30". The bushing 70 is attached at its first end, on the side of the first end 28' of the piston member 28, to the body 18. The piston member 28 comprises a sleeve member 46 which is arranged in the second space section 30" such that a desired guidance and sealing is provided corresponding to the figures 1 and 2. In the second space section 30" the inner wall of the second space section 30" and the wall of the sleeve member 46 are arranged against each other providing a second sealing gap 35 between the walls, respectively. The sleeve member 46 is arranged to extend into said annular gap 60 formed by the bushing 70 and the wall of the second space section

30". This way the bushing 70 borders the second pump chamber 16' together with sleeve member 46 and the piston member 28. The fitting of the sleeve member 46 to extend into the annular gap between the bushing 70 and wall of the second space section 30" is such that the radially inner wall of the annular gap i.e. the radially outer wall of the bushing 70 and the radially inner wall of the sleeve member 46 are against each other providing a third sealing gap 37.

[0039] In the figure 4 there is a third space section 60 arranged into the annular gap radially between the bushing 70 and the inner wall of the body and the sleeve member 49 which borders the third space section 60. The third space section 60 serves for purposes of lubrication the pump 10. The pump 10 is provided with lubrication oil supply channel 62 and a lubrication oil discharge channel 64. The lubrication oil supply channel 62 is arranged to a position so as to supply oil to the second sealing gap 35. The lubrication oil discharge channel 64 is positioned to open in to the third space section 60.

[0040] The pump 10 is provided with means for transferring fuel material away from the second pump chamber 16'. Therefore firstly the pump 10 is provided with a vent flow path 36. The vent flow path 36 runs through the body 18 of the pump and connects the second pump chamber 16' which is formed into the second space section 30" to outside of the body 18. The vent flow path 36 is configured to allow gas admission into the second space section 30", driven by the reciprocating movement of the piston member 28. The pump 10 is further provided with a discharge flow path 38 connecting the second pump chamber 16' to outside of the body 18 configured to transfer fuel material entered into the second pump chamber 16' or the second space section 30" via the sealing gap 34 away from the second space section 30" i.e. the second pump chamber 16'.

[0041] The vent flow path 36 is provided with a one-way valve 40 which allows gas flow in the vet flow path 36 in the direction towards the second space section 30" and prevent back flow of the fluid. The vent flow path 36 has an inlet which opens into the surroundings of the pump 10. Respectively, the discharge flow path 38 is provided with a one-way valve 42 configured to allow flow away from the second space section 30" via the discharge flow path 38. During compression stroke of the volume of the second pump chamber 16' is reduced and due to that it is pressurized. Gases and liquids within the second pump chamber 16' are forced out from the second pump chamber 16' via the discharge one-way valve 42. During suction stroke of the pump also the second pump chamber 16' expands causing suction through the vent one-way valve 40.

[0042] The sealing effect of the sealing gaps above may be based on qualities of the surface and/or dimension tolerances of parts and/or separate sealing elements, such as an o-ring or a lip seal.

[0043] While the invention has been described herein by way of examples in connection with what are, at present, considered to be the most preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but is intended to cover various modifications as long as these are included within the scope of the invention, as defined in the appended claims.

Claims

1. A fuel pump (10) for supplying fuel to an internal combustion piston engine, comprising:

a body (18) and a cylindrical space (30) arranged in the body having a central axis (32),
a piston member (28) arranged to reciprocate in the cylindrical space (30),
where the cylindrical space (30) comprises a first space section (30') having a first diameter (D1) in which the wall of the space and the wall of the piston member (28) are arranged against each other providing a first sealing gap (34) such that the wall of the space (30) guides the piston member (28) in the body (18), and
where the first space section (30') is bordered by a first end (28') of the piston member (28) forming a first pumping chamber (16) of the fuel pump (10) configured to pump the fuel as the piston member (28) reciprocates in the space, and where the cylindrical space (30) further comprises a second space section (30") on the central axis (32) having a second diameter (D2) greater than the first diameter (D1),
and where the piston member is provided with a sleeve member (46) extending towards the first end (28') of the piston member (28) such that an annular space is provided between the sleeve member (46) and the piston member (28), which annular space opens towards the first end (28') of the piston member (28), and where an inner wall of the second space section (30") and a radially outer wall of the sleeve member (46) are arranged against each other providing a second sealing gap (35) such that the inner wall of the second space section (30') guides the sleeve member (46) in the second space section (30"), and
wherein the pump body (18) is provided with a cylindrical extension (48) which is coaxial to the first space section (30') forming an annular gap circumscribing the piston member (28), wherein the sleeve member (48) is arranged to extend into the annular gap between the cylindrical extension (48) and inner wall of the second space section (30"), wherein an annular third space section (60) is arranged into fuel pump (10) which third space section (60) is partially bordered by the inner wall of the second space sec-

tion (30"), the outer wall of the cylindrical extension (48) and the sleeve member (46) which is arranged to extend into the annular third space section (60), **characterised in**
that the second space section (30") is provided with a second pumping chamber (16') of the pump configured to pump fuel from the second space section (30"), as the piston member (28) reciprocates in the space (30), and the pump (10) is provided with a vent flow path (36) connecting the second space section (30") to outside of the body for allowing gas admission into the second space section (30"), driven by the reciprocating movement of the piston member, and a discharge flow path (38) connecting the second space section (30") to outside of the body for transferring fuel material away from the second space section (30"),
and in that a lubrication oil supply channel (62) and a lubrication oil discharge channel (64) are connected to the third space section (60).

2. A fuel pump according to claim 1, **characterized in that** the vent flow path (36) is provided with a one-way valve (40) allowing flow towards the second space section (30").

3. A fuel pump according to claim 1 **characterized in that** the discharge flow path is provided with a one-way valve (42) allowing flow away from the second space section (30").

4. A fuel pump according to claim 1, **characterized in that** the annular gap in the second space section (30") circumscribes the first space section at least partially such that the annular gap and the first space section (30') are overlapping with each other in the direction of the central axis (32) of the cylindrical space.

5. A fuel pump (10) according to claim 1, **characterized in that** the cylindrical extension (48) is a bushing (70) removably attached to the body (18) of the pump (10).

Patentansprüche

1. Kraftstoffpumpe (10) zum Zuführen von Kraftstoff zu einem Kolbenverbrennungsmotor, umfassend:

einen Körper (18) und einen zylindrischen Raum (30), der in dem Körper angeordnet ist und eine Mittelachse (32) aufweist,
ein Kolbenelement (28), das angeordnet ist, um sich in dem zylindrischen Raum (30) hin- und herzubewegen,
wobei der zylindrische Raum (30) einen ersten Raumabschnitt (30') mit einem ersten Durchmesser (D1) umfasst, in dem die Wand des Raums und die Wand des Kolbenelements (28) aneinander angeordnet sind, wobei ein erster Dichtungsspalt (34) vorgesehen ist, sodass die Wand des Raums (30) das Kolbenelement (28) in dem Körper (18) führt, und
wobei der erste Raumabschnitt (30') von einem ersten Ende (28') des Kolbenelements (28) begrenzt ist, das eine erste Pumpkammer (16) der Kraftstoffpumpe (10) bildet, die eingerichtet ist, um den Kraftstoff zu pumpen, wenn sich das Kolbenelement (28) in dem Raum hin- und herbewegt, und wobei der zylindrische Raum (30) ferner einen zweiten Raumabschnitt (30") auf der Mittelachse (32) umfasst, der einen zweiten Durchmesser (D2) aufweist, der größer als der erste Durchmesser (D1) ist,
und wobei das Kolbenelement mit einem Hülsenelement (46) versehen ist, das sich derart in Richtung des ersten Endes (28') des Kolbenelements (28) erstreckt, dass ein ringförmiger Raum zwischen dem Hülsenelement (46) und dem Kolbenelement (28) vorgesehen ist, wobei sich der ringförmige Raum in Richtung des ersten Endes (28') des Kolbenelements (28) öffnet, und wobei eine innere Wand des zweiten Raumabschnitts (30") und eine radial äußere Wand des Hülsenelements (46) aneinander angeordnet sind, wobei ein zweiter Dichtungsspalt (35) vorgesehen ist, sodass die innere Wand des zweiten Raumabschnitts (30') das Hülsenelement (46) in dem zweiten Raumabschnitt (30") führt, und
wobei der Pumpenkörper (18) mit einer zylindrischen Verlängerung (48) versehen ist, die koaxial zu dem ersten Raumabschnitt (30') ist, wobei ein ringförmiger Spalt gebildet ist, der das Kolbenelement (28) umgibt,
wobei das Hülsenelement (48) angeordnet ist, um sich in den ringförmigen Spalt zwischen der zylindrischen Verlängerung (48) und der inneren Wand des zweiten Raumabschnitts (30") zu erstrecken,
wobei ein ringförmiger dritter Raumabschnitt (60) in der Kraftstoffpumpe (10) angeordnet ist, wobei der dritte Raumabschnitt (60) teilweise durch die innere Wand des zweiten Raumabschnitts (30''), die äußere Wand der zylindrischen Verlängerung (48) und das Hülsenelement (46) begrenzt ist, das angeordnet ist, um sich in den ringförmigen dritten Raumabschnitt (60) zu erstrecken,
dadurch gekennzeichnet, dass der zweite Raumabschnitt (30") mit einer zweiten Pumpkammer (16') der Pumpe versehen ist, die eingerichtet ist, um Kraftstoff aus dem zweiten Raumabschnitt (30") zu pumpen, wenn sich das

Kolbenelement (28) in dem Raum (30) hin- und herbewegt, und die Pumpe (10) mit einem Entlüftungsströmungsweg (36) versehen ist, der den zweiten Raumabschnitt (30") mit einem Äußeren des Körpers verbindet, um einen Gaseinlass in den zweiten Raumabschnitt (30") zu ermöglichen, der durch die Hin- und Herbewegung des Kolbenelements angetrieben wird, und mit einem Auslassströmungsweg (38), der den zweiten Raumabschnitt (30") mit einem Äußeren des Körpers verbindet, um Kraftstoffmaterial von dem zweiten Raumabschnitt (30") weg zu befördern,
und dadurch, dass ein Schmierölzufuhrkanal (62) und ein Schmierölauslasskanal (64) mit dem dritten Raumabschnitt (60) verbunden sind.

2. Kraftstoffpumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** der Entlüftungsströmungsweg (36) mit einem Einwegventil (40) versehen ist, das ein Strömen in Richtung des zweiten Raumabschnitts (30") ermöglicht.

3. Kraftstoffpumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** der Auslassströmungsweg mit einem Einwegventil (42) versehen ist, das ein Strömen von dem zweiten Raumabschnitt (30") weg ermöglicht.

4. Kraftstoffpumpe nach Anspruch 1, **dadurch gekennzeichnet, dass** der ringförmige Spalt in dem zweiten Raumabschnitt (30'') den ersten Raumabschnitt zumindest teilweise derart umgibt, dass der ringförmige Spalt und der erste Raumabschnitt (30') einander in der Richtung der Mittelachse (32) des zylindrischen Raums überlappen.

5. Kraftstoffpumpe (10) nach Anspruch 1, **dadurch gekennzeichnet, dass** die zylindrische Verlängerung (48) eine Buchse (70) ist, die abnehmbar an dem Körper (18) der Pumpe (10) angebracht ist.

Revendications

1. Pompe à carburant (10) destinée à alimenter un moteur à piston à combustion interne, comprenant :

un corps (18) et un espace cylindrique (30) agencé dans le corps présentant un axe central (32),
un élément de piston (28) conçu pour effectuer un mouvement de va-et-vient dans l'espace cylindrique (30),
dans laquelle l'espace cylindrique (30) comprend une première section d'espace (30') présentant un premier diamètre (D1) dans lequel la paroi de l'espace et la paroi de l'élément de piston (28) sont disposées l'une contre l'autre, fournissant un premier interstice d'étanchéité (34), de telle façon que la paroi de l'espace (30) guide l'élément de piston (28) dans le corps (18), et
dans laquelle la première section d'espace (30') est délimitée par une première extrémité (28') de l'élément de piston (28) formant une première chambre de pompage (16) de la pompe à carburant (10) configurée pour pomper le carburant tandis que l'élément de piston (28) effectue un mouvement de va-et-vient dans l'espace, et
dans laquelle l'espace cylindrique (30) comprend en outre une deuxième section d'espace (30'') sur l'axe central (32), laquelle présente un deuxième diamètre (D2) supérieur au premier diamètre (D1),
et dans laquelle l'élément de piston est doté d'un élément de manchon (46) s'étendant vers la première extrémité (28') de l'élément de piston (28), de telle façon qu'un espace annulaire est fourni entre l'élément de manchon (46) et l'élément de piston (28), ledit espace annulaire s'ouvrant vers la première extrémité (28') de l'élément de piston (28), et
dans laquelle une paroi intérieure de la deuxième section d'espace (30'') et une paroi radialement extérieure de l'élément de manchon (46) sont disposées l'une contre l'autre, fournissant un deuxième interstice d'étanchéité (35) de telle façon que la paroi intérieure de la deuxième section d'espace (30') guide l'élément de manchon (46) dans la deuxième section d'espace (30''), et
dans laquelle le corps de pompe (18) est doté d'une extension cylindrique (48), laquelle est coaxiale à la première section d'espace (30') formant un interstice annulaire circonscrivant l'élément de piston (28), dans laquelle
l'élément de manchon (48) est disposé de manière à s'étendre dans l'interstice annulaire entre l'extension cylindrique (48) et la paroi intérieure de la deuxième section d'espace (30''), dans laquelle une troisième section d'espace annulaire (60) est disposée dans la pompe à carburant (10), ladite troisième section d'espace (60) étant délimitée partiellement par la paroi intérieure de la deuxième section d'espace (30''), la paroi extérieure de l'extension cylindrique (48) et l'élément de manchon (46) disposé de manière à s'étendre dans la troisième section d'espace annulaire (60),
caractérisée en ce que
la deuxième section d'espace (30'') est dotée d'une deuxième chambre de pompage (16') de la pompe configurée pour pomper du carburant à partir de la deuxième section d'espace (30"), tandis que l'élément de piston (28) effectue un mouvement de va-et-vient dans l'espace (30),

et la pompe (10) est dotée d'un trajet d'écoulement d'évent (36) reliant la deuxième section d'espace (30'') à l'extérieur du corps pour permettre une entrée de gaz dans la deuxième section d'espace (30''), entraînée par le mouvement de va-et-vient de l'élément de piston, et un trajet d'écoulement de décharge (38) reliant la deuxième section d'espace (30") à l'extérieur du corps pour évacuer de la matière combustible à partir de la deuxième section d'espace (30"),
et **en ce qu'**un canal d'alimentation en huile lubrifiante (62) et un canal de décharge d'huile lubrifiante (64) sont raccordés à la troisième section d'espace (60).

2. Pompe à carburant selon la revendication 1, **caractérisée en ce que** le trajet d'écoulement d'évent (36) est doté d'une soupape unidirectionnelle (40) permettant un écoulement vers la deuxième section d'espace (30'').

3. Pompe à carburant selon la revendication 1, **caractérisée en ce que** le trajet d'écoulement de décharge est doté d'une soupape unidirectionnelle (42) permettant un écoulement à distance de la deuxième section d'espace (30'').

4. Pompe à carburant selon la revendication 1, **caractérisée en ce que** l'interstice annulaire dans la deuxième section d'espace (30") circonscrit la première section d'espace au moins partiellement de telle façon que l'interstice annulaire et la première section d'espace (30') se chevauchent entre eux dans la direction de l'axe central (32) de l'espace cylindrique.

5. Pompe à carburant (10) selon la revendication 1, **caractérisée en ce que** l'extension cylindrique (48) est une douille (70) fixée de façon amovible au corps (18) de la pompe (10).

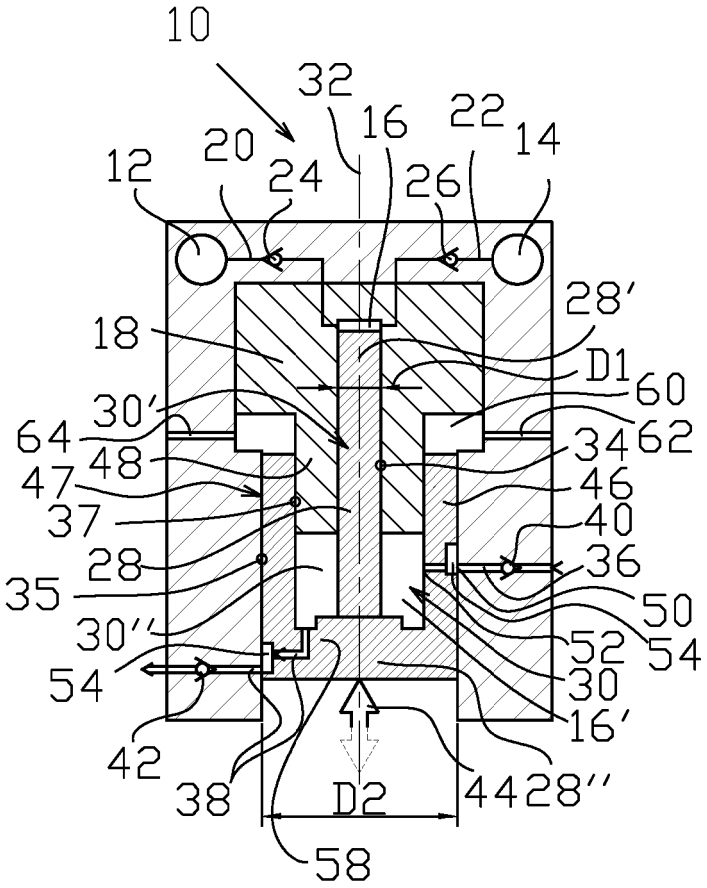
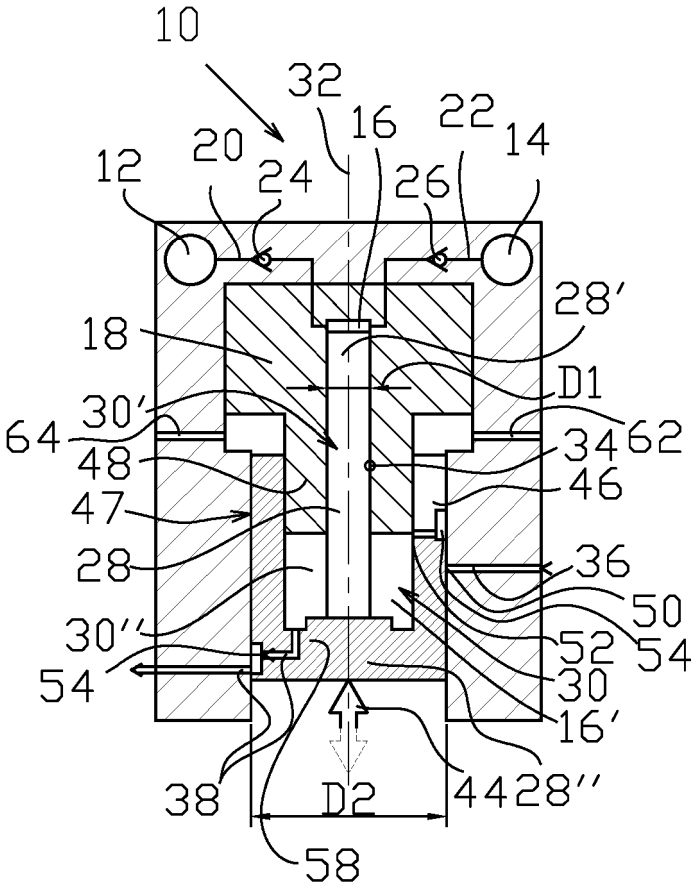

10
32
16
22
14
20
24
26
12
28'
18
D1
60
30'
64
62
34
48
47
46
37
40
28
36
35
50
30''
52
54
54
30
16'
42
38
D2
44
28''
58

Fig. 1


10
32
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12
28'
18
D1
30'
64
62
34
48
46
47
36
28
50
30''
52
54
54
30
16'
38
D2
44
28''
58

Fig. 2

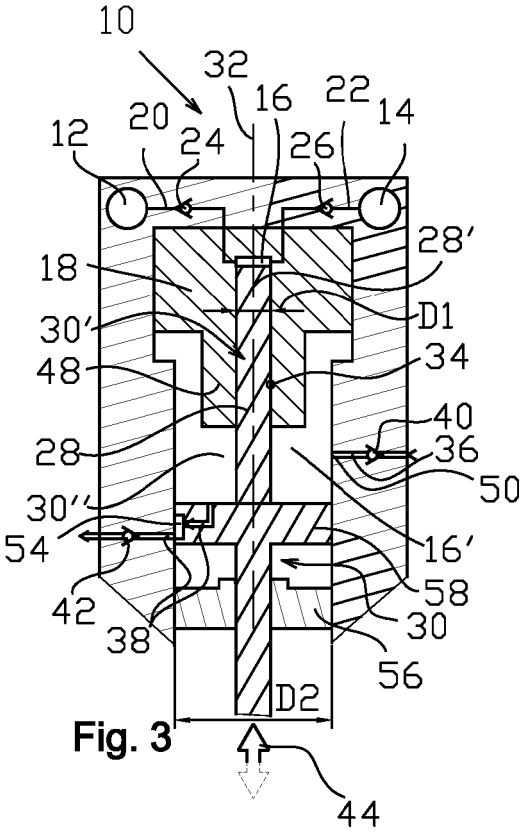
10
32
16
22
14
20
24
26
12
28'
18
D1
30'
34
48
40
36
28
50
30''
54
16'
58
42
30
38
56
D2
44

Fig. 3

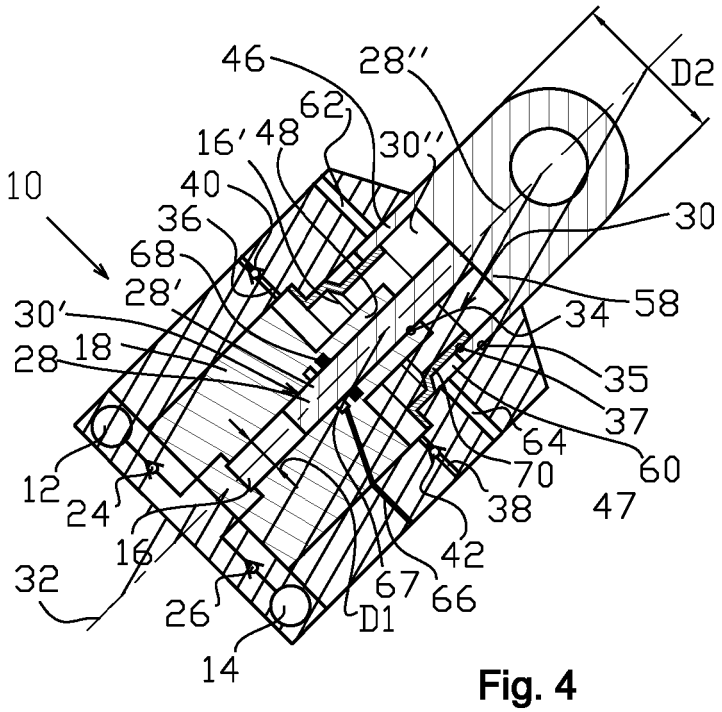
46
28''
D2
62
16'
48
30''
10
40
36
30
68
28'
58
30'
34
28
18
35
37
64
60
12
70
24
38
47
16
42
32
67
66
26
D1
14

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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